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(54) **FIELD OF VISION CAPTURE**

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(51) **Int. Cl.**

G06K 9/00 (2006.01)

G06F 3/00 (2006.01)

(52) **U.S. Cl.**

CPC ***G06K 9/00597*** (2013.01); ***G06F 3/00*** (2013.01); ***G06K 9/00355*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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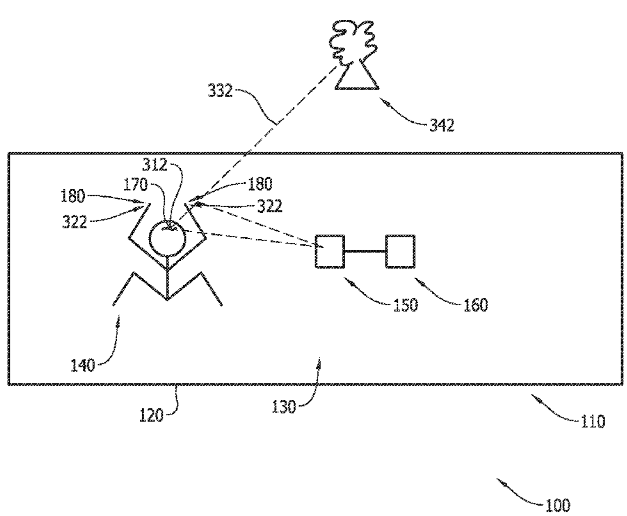
(57) **ABSTRACT**

A system includes at least one sensor, and a computing device coupled to the at least one sensor. The computing device includes a processor, and a computer-readable storage media having computer-executable instructions embodied thereon. When executed by at least one processor, the computer-executable instructions cause the processor to identifying a dominant eye of the occupant, determine a first position associated with the dominant eye of the occupant, determine a second position associated with the occupant, and determine a first line-of-sight by extending a first line-of-sight between the first position and the second position.

17 Claims, 3 Drawing Sheets



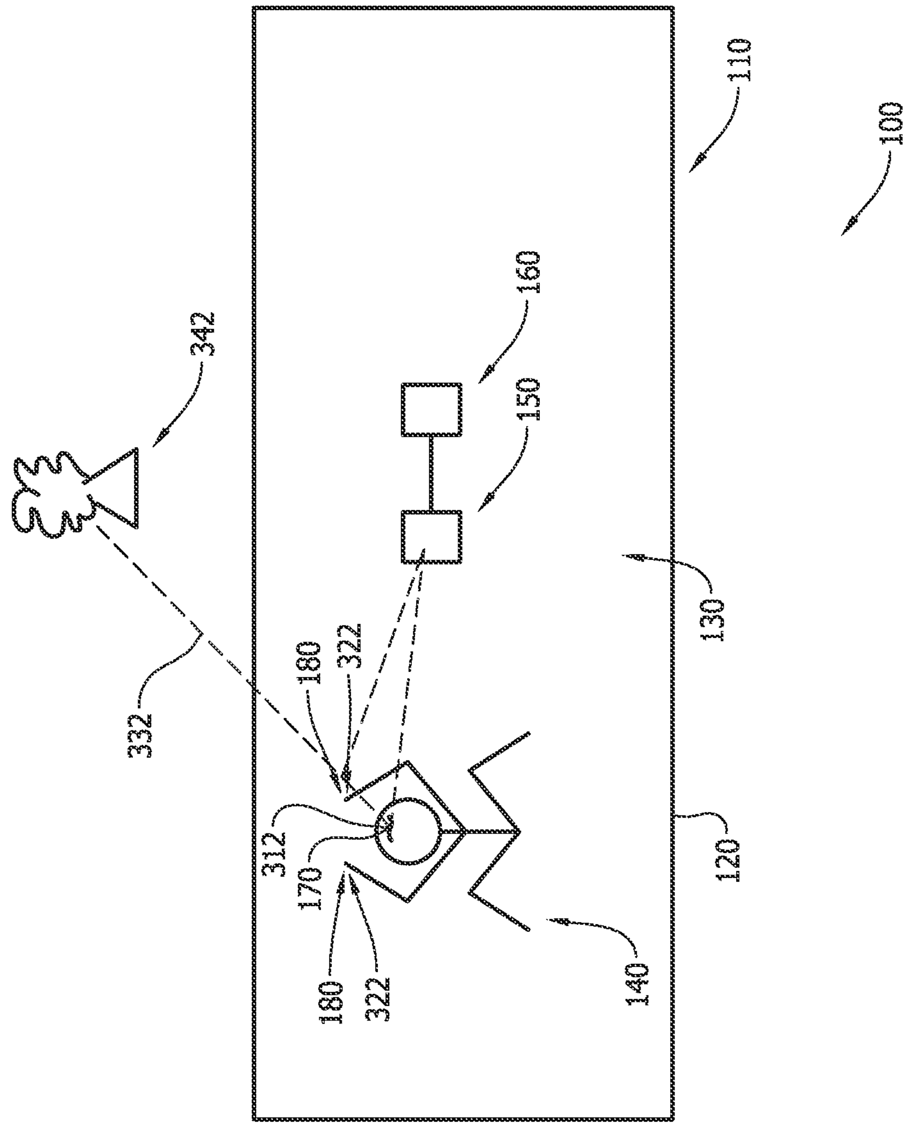


FIG. 1

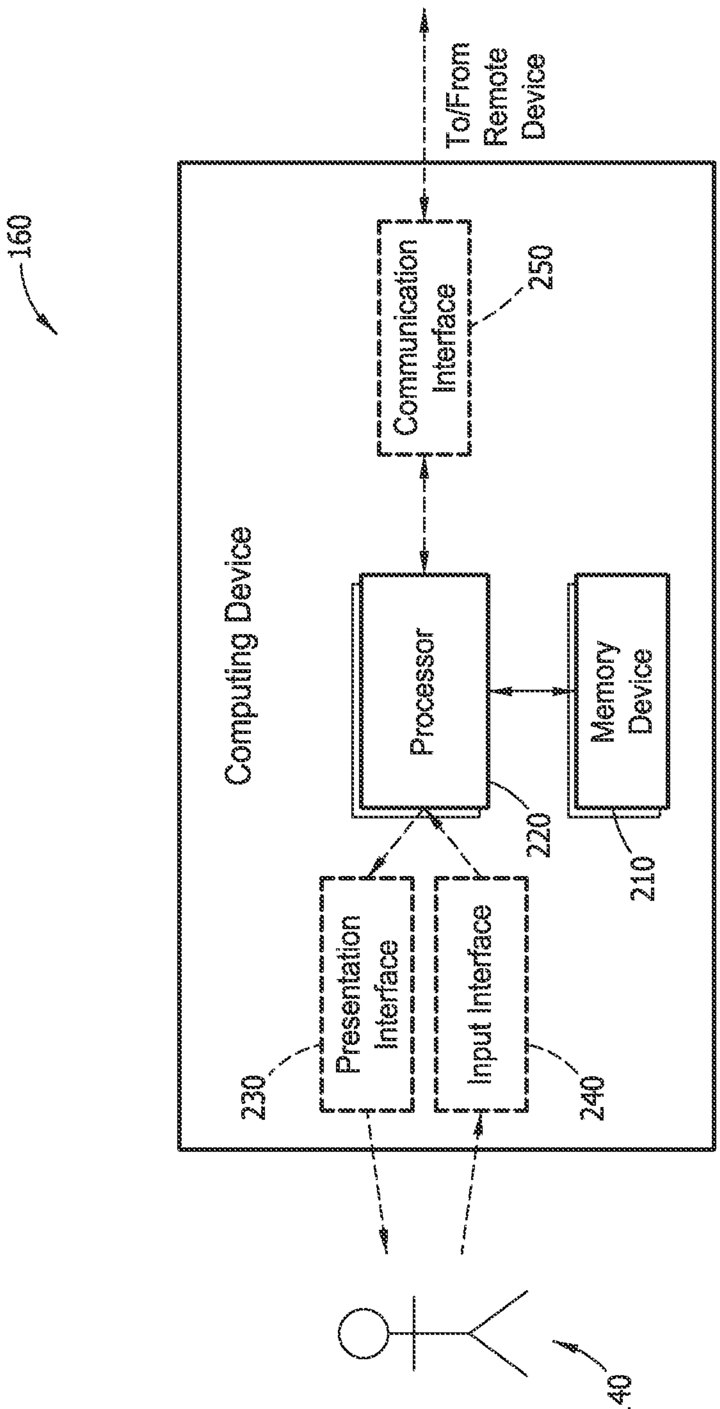

160
To/From
Remote
Device
Computing Device
Communication
Interface
250
Processor
220
Memory
Device
210
Presentation
Interface
230
Input Interface
240
140

FIG. 2

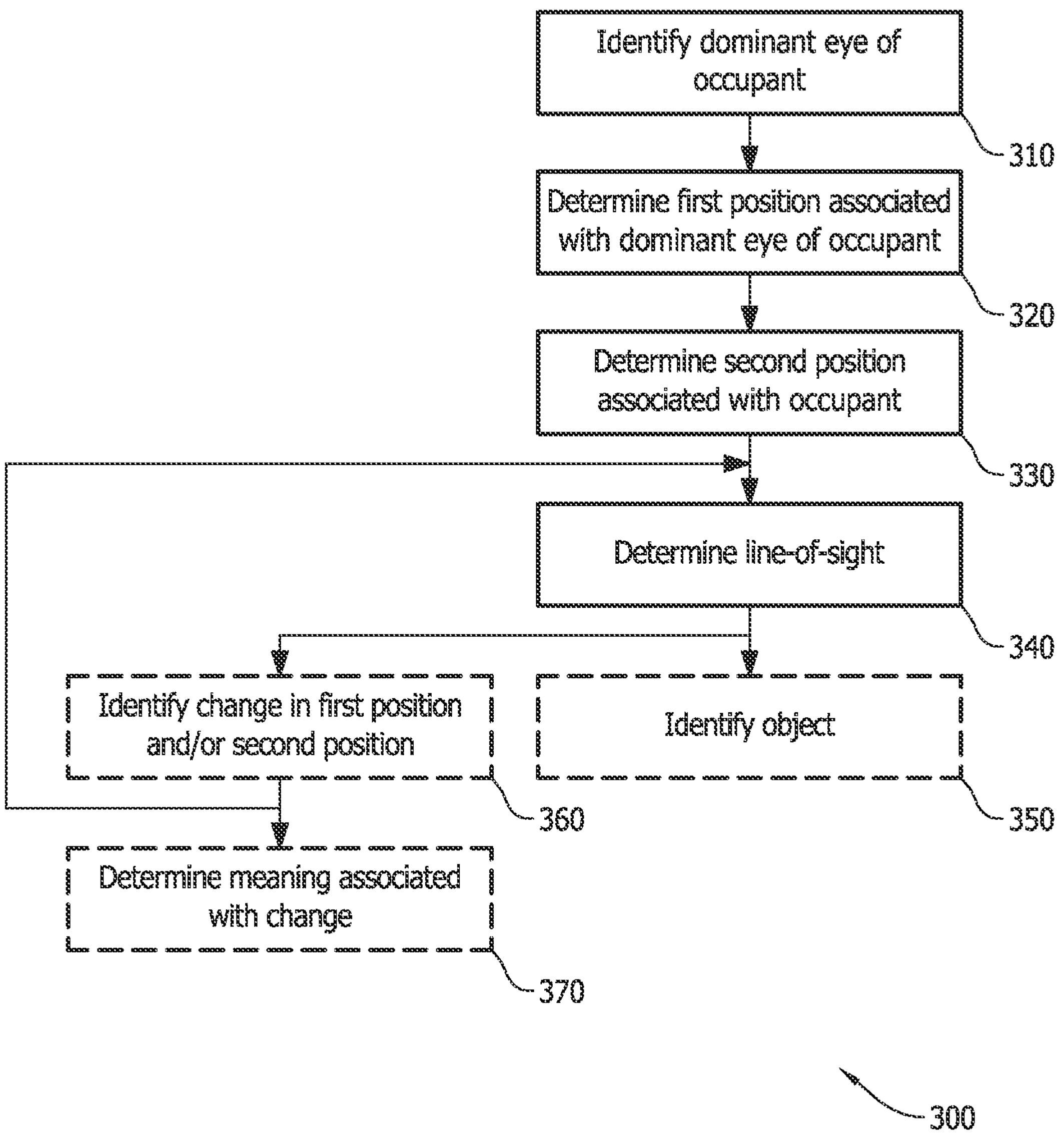

Identify dominant eye of occupant
310
Determine first position associated with dominant eye of occupant
320
Determine second position associated with occupant
330
Determine line-of-sight
340
Identify change in first position and/or second position
360
Identify object
350
Determine meaning associated with change
370
300

FIG. 3

FIELD OF VISION CAPTURE

BACKGROUND

The present disclosure relates to human-machine interface (HMI) systems and, more particularly, to methods and systems for determining a field of vision associated with an occupant of a vehicle.

At least some known HMI systems determine a line-of-sight associated with a user by detecting a position and an orientation of an eye of the user. However, determining the line-of-sight based on the position and the orientation of only the eye may be speculative and/or difficult because the line-of-sight is determined based on only one reference point (i.e., the user's eye).

BRIEF SUMMARY

In one aspect, a method is provided for determining a field of vision associated with an occupant of a vehicle. The method includes identifying a dominant eye of the occupant, determining a first position associated with a dominant eye of the occupant, determining a second position associated with the occupant, and determining a first line-of-sight by extending a first line-of-sight between the first position and the second position.

In another aspect, one or more computer-readable storage media are provided. The one or more computer-readable storage media has computer-executable instructions embodied thereon. When executed by at least one processor, the computer-executable instructions cause the processor to identify a dominant eye of the occupant, determine a first position associated with the dominant eye of the occupant, determine a second position associated with the occupant, and determine a first line-of-sight by extending a first line-of-sight between the first position and the second position.

In yet another aspect, a system is provided. The system includes at least one sensor, and a computing device coupled to the at least one sensor. The computing device includes a processor, and a computer-readable storage media having computer-executable instructions embodied thereon. When executed by at least one processor, the computer-executable instructions cause the processor to identify a dominant eye of the occupant, determine a first position associated with the dominant eye of the occupant, determine a second position associated with the occupant, and determine a first line-of-sight by extending a first line-of-sight between the first position and the second position.

The features, functions, and advantages described herein may be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments, further details of which may be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of an exemplary human-machine interface (HMI) system environment;

FIG. **2** is a schematic illustration of an exemplary computing device that may be used in the HMI system environment described in FIG. **1**;

FIG. **3** is a flowchart of an exemplary method that may be implemented by the computing device shown in FIG. **2**.

Although specific features of various implementations may be shown in some drawings and not in others, this is for convenience only. Any feature of any drawing may be referenced and/or claimed in combination with any feature of any other drawing.

DETAILED DESCRIPTION OF THE INVENTION

The present disclosure relates to human-machine interface (HMI) systems and, more particularly, to methods and systems for determining a field of vision associated with an occupant of a vehicle. In one embodiment, a system includes at least one sensor, and a computing device coupled to the at least one sensor. The computing device includes a processor, and a computer-readable storage media having computer-executable instructions embodied thereon. When executed by at least one processor, the computer-executable instructions cause the processor to identify a dominant eye of the occupant, determine a first position associated with the dominant eye of the occupant, determine a second position associated with the occupant, and determine a first line-of-sight by extending a first line-of-sight between the first position and the second position.

As used herein, an element or step recited in the singular and preceded with the word "a" or "an" should be understood as not excluding plural elements or steps, unless such exclusion is explicitly recited. Furthermore, references to one "implementation" or one "embodiment" of the subject matter described herein are not intended to be interpreted as excluding the existence of additional implementations that also incorporate the recited features. The following detailed description of implementations consistent with the principles of the disclosure refers to the accompanying drawings. In the absence of a contrary representation, the same reference numbers in different drawings may identify the same or similar elements.

FIG. **1** is a schematic illustration of an exemplary HMI system environment **100**. In the exemplary embodiment, environment **100** includes a vehicle **110** including a frame **120** that defines a cabin **130** therein. Vehicle **110** may be any vessel, aircraft, and/or vehicle including, without limitation, an automobile, a truck, a boat, a helicopter, and/or an airplane. In at least some implementations, an occupant **140** (e.g., a drive or a passenger) may sit and/or be positioned within cabin **130**.

In the exemplary embodiment, vehicle **110** includes at least one sensor **150** and a computing device **160** coupled to sensor **150**. In the exemplary embodiment, sensor **150** is configured to detect a position of at least one part of occupant **140**. For example, in one implementation, sensor **150** is oriented to detect an eye position **170** and/or a hand position **180** associated with occupant **140**. As used herein, the term "eye position" may refer to a position and/or orientation of an eye, a cornea, a pupil, an iris, and/or any other part on the head that enables the methods and systems to function as described herein. As used herein, the term "hand position" may refer to a position and/or orientation of a hand, a wrist, a palm, a finger, a fingertip, and/or any other part adjacent to the end of an arm that enables the methods and systems to function as described herein. Any number of sensors **150** may be used to detect any number of parts of occupant **140** that enable the methods and systems to function as described herein. Additionally or alternatively, sensor **150** may be used to detect a prop, a stylus, and/or a wand associated with occupant **140**.

FIG. **2** is a schematic illustration of computing device **160**. In the exemplary embodiment, computing device **160** includes at least one memory device **210** and a processor **220** that is coupled to memory device **210** for executing instructions. In some implementations, executable instructions are stored in memory device **210**. In the exemplary embodiment, computing device **160** performs one or more operations described herein by programming processor **220**. For example, processor **220** may be programmed by encoding an operation as one or more executable instructions and by providing the executable instructions in memory device **210**.

Processor **220** may include one or more processing units (e.g., in a multi-core configuration). Further, processor **220** may be implemented using one or more heterogeneous processor systems in which a main processor is present with secondary processors on a single chip. In another illustrative example, processor **220** may be a symmetric multi-processor system containing multiple processors of the same type. Further, processor **220** may be implemented using any suitable programmable circuit including one or more systems and microcontrollers, microprocessors, reduced instruction set circuits (RISC), application specific integrated circuits (ASIC), programmable logic circuits, field programmable gate arrays (FPGA), and any other circuit capable of executing the functions described herein.

In the exemplary embodiment, memory device **210** is one or more devices that enable information such as executable instructions and/or other data to be stored and retrieved. Memory device **210** may include one or more computer readable media, such as, without limitation, dynamic random access memory (DRAM), static random access memory (SRAM), a solid state disk, and/or a hard disk. Memory device **210** may be configured to store, without limitation, application source code, application object code, source code portions of interest, object code portions of interest, configuration data, execution events and/or any other type of data.

In the exemplary embodiment, computing device **160** includes a presentation interface **230** that is coupled to processor **220**. Presentation interface **230** is configured to present information to occupant **140** (shown in FIG. **1**). For example, presentation interface **230** may include a display adapter (not shown) that may be coupled to a display device, such as a cathode ray tube (CRT), a liquid crystal display (LCD), an organic LED (OLED) display, and/or an "electronic ink" display. In some implementations, presentation interface **230** includes one or more display devices.

In the exemplary embodiment, computing device **160** includes a user input interface **240** that is coupled to processor **220**. User input interface **240** is configured to receive input from occupant **140**. User input interface **240** may include, for example, a keyboard, a pointing device, a mouse, a stylus, a touch sensitive panel (e.g., a touch pad or a touch screen), a gyroscope, an accelerometer, a position detector, and/or an audio user input interface. A single component, such as a touch screen, may function as both a display device of presentation interface **230** and user input interface **240**.

Computing device **160**, in the exemplary embodiment, includes a communication interface **250** coupled to processor **220**. Communication interface **250** communicates with one or more remote devices, such as sensor **150** (shown in FIG. **1**). To communicate with remote devices, communication interface **250** may include, for example, a wired network adapter, a wireless network adapter, and/or a mobile telecommunications adapter.

FIG. **3** is a flowchart of an exemplary method **300** that may be implemented by computing device **160** (shown in FIGS. **1** and **2**). In the exemplary embodiment, a dominant eye of occupant **140** (shown in FIG. **1**) is detected and/or identified **310**. More specifically, in the exemplary embodiment, computing device **160** identifies **310** the dominant eye based at least partially on a signal transmitted by sensor **150** and/or received by computing device **160**.

For example, in one implementation, the dominant eye may be detected by detecting a first parameter associated with a first eye of occupant **140**, detecting a second parameter associated with a second eye of occupant **140**, and determining which eye is the dominant eye based on the detected parameters. The dominant eye may be determined using any method and/or system including, without limitation, the Miles test, the Porta test, the Dolman method, a convergence near-point test, a stereogram, a pinhole test, a ring test, and/or a lens fogging technique. Additionally or alternatively, the dominant eye may be identified **310** based at least partially on user input and/or an algorithm or rule set stored in memory device **210**.

In the exemplary embodiment, a first position **312** (shown in FIG. **1**) associated with the dominant eye of occupant **140** is determined **320**. For example, in one implementation, an eye position associated with occupant **140** is detected to determine **320** first position **312**. Alternatively, any part of occupant **140** may be detected to determine first position **312** that enables the methods and systems to function as described herein. In at least some implementations, the first part is detected using a depth-sensing camera to enable three-dimensional coordinates for first position **312** to be determined.

In the exemplary embodiment, a second position **322** (shown in FIG. **1**) associated with occupant **140** is determined **330**. For example, in one implementation, a hand or, more specifically, a fingertip position associated with occupant **140** is detected to determine **330** second position **322**. Alternatively, any part associated with occupant **140** including, without limitation, a body part, a prop, a stylus, and/or a wand may be detected to determine second position **322** that enables the methods and systems to function as described herein. In at least some implementations, the second part is detected using the depth-sensing camera (or another depth-sensing camera) to enable three-dimensional coordinates for second position **322** to be determined.

In the exemplary embodiment, a first line-of-sight **332** (shown in FIG. **1**) is determined **340** based at least partially on the first position and the second position. For example, in one implementation, at least a portion of first line-of-sight **332** extends between first position **312** and second position **322**. That is, in the exemplary embodiment, computing device **160** determines **340** that first line-of-sight **332** extends from the first position (e.g., the eye position) towards the second position (e.g., the fingertip position).

In the exemplary embodiment, an object **342** (shown in FIG. **1**) outside vehicle **110** (shown in FIG. **1**) is identified **350** as being in a field of vision of occupant **140** based at least partially on first line-of-sight **332**. For example, in one implementation, first line-of-sight **332** is extrapolated from first position **312** beyond second position **322** to object **342**. Accordingly, in such an implementation, a vector extends from first position **312**, through second position **322**, and points to object **342**.

In at least some implementations, a change (not shown) in first position **312** and/or second position **322** is identified **360**, and a second line-of-sight (not shown) is determined **340** based at least partially on first line-of-sight **332** and/or the change. For example, in one implementation, first line-of-sight **332** extends between first position **312** and second position **322** before the change, and the second line-of-sight extends between first position **312** and second position **322** after the change.

In at least some implementations, a change in first position **312** and/or second position **322** is identified **360**, and a meaning associated with the change is determined **370**. For example, in one implementation, the change is interpreted as a gesture that is associated with a predetermined meaning. In such an implementation, occupant **140** may interact with a virtual representation of object **342** by, for example, touching and/or twirling the fingertip.

The methods and systems described herein may be implemented using computer programming or engineering techniques including computer software, firmware, hardware or any combination or subset thereof, wherein the technical effects may be achieved by performing at least one of the following steps: a) determining a first position associated with a first part of the occupant; b) determining a second position associated with a second part of the occupant; and/or c) determining a first line-of-sight based at least partially on the first position and the second position.

The present disclosure relates generally to HMI systems and, more particularly, to methods and systems for determining a field of vision associated with an occupant of a vehicle. Accordingly, the methods and systems described herein facilitate determining and/or identifying objects in a field of vision for each occupant of a vehicle based on a respective eye position, head position, hand position, and/or fingertip position.

Exemplary embodiments of a HMI system are described above in detail. The methods and systems are not limited to the specific embodiments described herein, but rather, components of systems and/or steps of the method may be utilized independently and separately from other components and/or steps described herein. Each method step and each component may also be used in combination with other method steps and/or components. Although specific features of various embodiments may be shown in some drawings and not in others, this is for convenience only. Any feature of a drawing may be referenced and/or claimed in combination with any feature of any other drawing.

This written description uses examples to disclose the embodiments, including the best mode, and also to enable any person skilled in the art to practice the embodiments, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the disclosure is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

What is claimed is:

1. A method of determining a field of vision associated with an occupant of a vehicle, the method comprising:

identifying a dominant eye of the occupant;

determining a first position associated with the dominant eye of the occupant;

determining a second position associated with the occupant;

determining a set of three-dimensional coordinates for each of the first position and the second position;

determining a first line-of-sight by extending a first line between the first position and the second position based on the three-dimensional coordinates for each of the first position and the second position; and

identifying an object outside the vehicle as being in the field of vision based at least partially on the first line-of-sight by extrapolating the first line-of-sight beyond the second position and outside the vehicle to the object located outside the vehicle.

2. A method in accordance with claim **1**, wherein identifying a dominant eye further comprises:

detecting a first parameter associated with a first eye of the occupant;

detecting a second parameter associated with a second eye of the occupant; and

determining the dominant eye based at least partially on the first parameter and the second parameter.

3. A method in accordance with claim **1**, wherein determining a first position further comprises detecting, using at least one depth-sensing camera, an eye position associated with the occupant.

4. A method in accordance with claim **1**, wherein determining a second position further comprises detecting, using at least one depth-sensing camera, a hand position associated with the occupant.

5. A method in accordance with claim **1** further comprising:

identifying a change in one of the first position and the second position; and

determining a second line-of-sight based at least partially on one of the first line-of-sight and the change.

6. A method in accordance with claim **1** further comprising:

identifying a change in one of the first position and the second position; and

determining a meaning associated with the change.

7. One or more non-transitory computer-readable storage media having computer-executable instructions embodied thereon, wherein, when executed by at least one processor, the computer-executable instructions cause the processor to:

identify a dominant eye of an occupant of a vehicle;

determine a first position associated with the dominant eye of the occupant;

determine a second position associated with the occupant;

determine a set of three-dimensional coordinates for each of the first position and the second position;

determine a first line-of-sight by extending a first line between the first position and the second position based on the three-dimensional coordinates for each of the first position and the second position; and

identify an object outside the vehicle as being in a field of vision of the occupant based at least partially on the first line-of-sight by extrapolating the first line-of-sight beyond the second position and outside the vehicle to the object located outside the vehicle.

8. One or more computer-readable storage media in accordance with claim **7**, wherein the computer-executable instructions further cause the processor to:

detect a first parameter associated with a first eye of the occupant;

detect a second parameter associated with a second eye of the occupant; and

determine the dominant eye based at least partially on the first parameter and the second parameter.

9. One or more computer-readable storage media in accordance with claim **7**, wherein the computer-executable instructions further cause the processor to detect, using at least one depth-sensing camera, an eye position associated with the occupant.

10. One or more computer-readable storage media in accordance with claim **7**, wherein the computer-executable instructions further cause the processor to detect, using at least one depth-sensing camera, a hand position associated with the occupant.

11. One or more computer-readable storage media in accordance with claim **7**, wherein the computer-executable instructions further cause the processor to:

identify a change in one of the first position and the second position; and

determine a second line-of-sight based at least partially on one of the first line-of-sight and the change.

12. One or more computer-readable storage media in accordance with claim **7**, wherein the computer-executable instructions further cause the processor to:

identify a change in one of the first position and the second position; and

determine a meaning associated with the change.

13. A system comprising:

at least one sensor; and

a computing device coupled to the at least one sensor, the computing device comprising a processor, and a computer-readable storage media having computer-executable instructions embodied thereon, wherein, when executed by at least one processor, the computer-executable instructions cause the processor to:

identify a dominant eye of an occupant of a vehicle;

determine a first position associated with the dominant eye of the occupant;

determine a second position associated with the occupant;

determine a set of three-dimensional coordinates for each of the first position and the second position;

determine a first line-of-sight by extending a first line between the first position and the second position based on the three-dimensional coordinates for each of the first position and the second position; and

identify an object outside the vehicle as being in a field of vision of the occupant based at least partially on the first line-of-sight by extrapolating the first line-of-sight beyond the second position and outside the vehicle to the object located outside the vehicle.

14. A system in accordance with claim **13**, wherein the computer-executable instructions further cause the processor to:

detect, using the at least one sensor, a first parameter associated with a first eye of the occupant;

detect, using the at least one sensor, a second parameter associated with a second eye of the occupant; and

determine the dominant eye based at least partially on the first parameter and the second parameter.

15. A system in accordance with claim **13**, wherein the computer-executable instructions further cause the processor to detect, using the at least one sensor, at least one of an eye position and a hand position associated with the occupant, wherein the at least one sensor is a depth-sensing camera.

16. A system in accordance with claim **13**, wherein the computer-executable instructions further cause the processor to:

identify a change in one of the first position and the second position; and

determine a second line-of-sight based at least partially on one of the first line-of-sight and the change.

17. A system in accordance with claim **13**, wherein the computer-executable instructions further cause the processor to:

identify a change in one of the first position and the second position; and

determine a meaning associated with the change.

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